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Design and Performance of a Gas-Fired Window Air Conditioner

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DESIGN AND PERFORMANCE OF A GAS-FIRED WINDOW AIR CONDITIONER

by

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SUMMARY

The existing window air conditioners are based on the vapor compression system utilizing electric energy which is mainly produced by burning the fossil fuels especially in third world countries. There are many countries around the world rich in natural gas with distribution network ,but short in electricity, while ,due to the hot climate ,the demand for window air conditioners is high. This paper presents a design, thermodynamics aspects, as well as some of the operational data of a gas fired window air conditioner based on Ammonia absorption system developed by authors.
The results obtained are promising and cost effective.

KEY WORDS

Absorption system, window Air Conditioner.

1-INTRODUCTION

The existing window air conditioners are based on vapor compression system employing hermetic compressor using electric energy.In spite of the simplicity of this system. There are some disadvantageous in utilizing this machine especially in countries rich of natural gas but short in electric power, in short, these are :
a- High energy consumption,when considering the efficiency of the power generating plants are about 1/3 of the total fuel energy.
b- Compressor is practically noisy with negative effects on the resident comfort, where as the air conditioning aim is better comfort.

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This work describes the development of a window air conditioner utilizes direct heat, with low level of generated noise and vibrations, very reliable and possibly maintenance free.

2-MATERIAL AND METHODS

Although the concept of the absorption refrigeration system is not new and the detail specifications of the system are available in literatures (1) , (2) and also, there are many well known manufacturers of this type of plant, but, little attempts are made in applying this concept to small air cooling unit (3).The cooling unit proposed in this paper is based on NH3 absorption system, the required heat energy is taken directly by burning the natural gas with calorific values of 39980 KJ/m^3 and pressure 17.8 cm water column, obtained from distribution pipe line. The boiler consist of a steel tube with 12 cm dia and 4 welded steel fin of 20 cm dia installed in the generator. Fig 1 presents the configuration and the main components of the machine,table (1) shows the summary of thermodynamics properties of the ammonia solution of the designed cycles, the highest temperature in the generator is 98 °C and the highest pressure in the cycles is 10 bar while the low pressure side is 1.7 in the Evaporator.

3-RESULTS AND DISCUSSION

The practical data and the C.O.P presented in Fig.2 (4) of about 0.5 obtained for this design reveals the possibility of using the ammonia absorption system for cooling the small residential area by this method of window air conditioner, although the weight of the unit is about 60 per cent more than the vapor compression system but is practically noiseless and maintenance free.The solution pump energy is about 200 watts and may be taken either from house electric network and or a rechargeable battery.

4-CONCLUSION AND SIGNIFICANT NEW FINDINGS OF THIS WORK

Application of this system for countries such as IRAN rich of natural gas and extended distribution network, but short of electricity has the following advantages.

a- Saving on individual electricity bill as well as the capital cost on electricity generating plant,especially when considering that the cooling units are used for a period of 3 to 4 months per year.

b- The system is noise less, simple and very reliable.

5-ACKNOWLEDGMENTS

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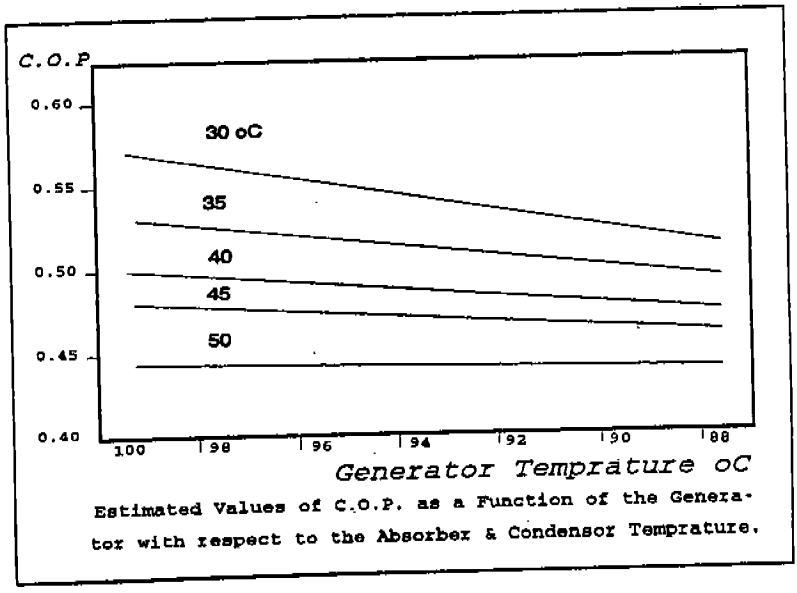
TABLE (I)

THERMODYNAMIC PROPERTIES OF THE REFRIGERANT					
Exit point	P-bar	Toc	X	W	H Kj/Kg
Absorber	1.7	32	0.36	3.05	-111.5
Generator	10.2	98	0.93	0.22	1557.0
Return	10.2	98	0.32	2.83	248.6
Condenser	10.0	30	0.93	0.22	83.6
Evaporator	1.7	-1	0.93	0.22	1041.1

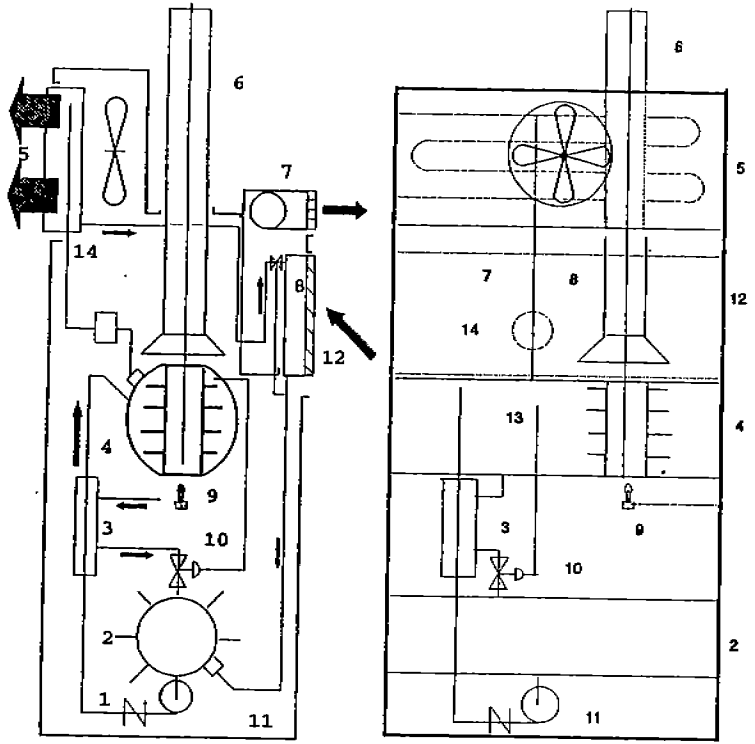
Summary of thermodynamics properties of aquamonia at different points of the designed cycles.

P Pressure bar
T Tempreture oc
W Mass flow of the refrigerant Kg/min
X Mass fraction
H Enthalpy Kj/Kg



Estimated Values of C.O.P. as a Function of the Generator with respect to the Absorber & Condensor Temprature.

Figure 2



LEGEND		
No.	NAME	SPECIFICATION
1	Check Valve	10 mm Dia Steel
2	Absorber Vessel	250 mm Dia. 800 mm Length
3	Heat Exchanger	Tube Type Aluminium Fin
4	Boiler & Generator	350 mm Dia.
5	Condensor	Aluminium Fin & Steel Tube
6	Chimney	80 mm Dia.
7	Centrifugal Fan	600 CFM Air Delilvery
8	Expansion Valve	Pressure 10 to 1.7 bar
9	Gas Burner	Atmospheric Type
10	P.R.V.Adjustable	10 to 1.7 bar
11	Circulating Pump	0.3 Lit/Min
12	Evaporator	Steel Tube & Al.Fin
13	Level Sensor	———
14	Water Seprator	———
15	Radial Fan	600 CFM Air Delivery

Fig. 1